POLICY BRIEF: The California Air Resources Board's U.S. Forest offset protocol underestimates leakage

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SUMMARY

Analysis of projects generating 80% of total offset credits issued by the California Air Resources Board's (ARB) U.S. Forest offset protocol finds that 82% of these credits likely do not represent true emissions reductions due to the protocol's use of lenient leakage accounting methods. The U.S. Forest protocol has generated 80% of the offset credits in California's cap-and-trade program. The total quantity of emissions allowed because of this over-crediting equals approximately 80 million tons of CO_2, which is one third of the total expected effect of California's cap-and-trade program during 2021 to 2030 (ARB 2017).

Leakage, in the context of the protocol, occurs when a reduction in timber harvesting at a project site causes an increase in timber harvesting elsewhere to meet timber demand. The way ARB's protocol accounts for leakage when calculating the number of credits awarded has three serious problems.

First, the protocol uses a 20% leakage rate when a rate of 80% or higher is supported by published studies of leakage rates from reduced timber harvesting in the United States (Gan & McCarl 2007, Wear & Murray 2004). Using an unsupported low rate results in over-crediting.

Second and more importantly, there is an inconsistency between the timing of when increases in on-site carbon storage and releases due to leakage are accounted for in the protocol's methods. Most improved forest management projects assume and credit a large reduction in timber harvesting in the first year of the offset project, but deduct the associated leakage over 100 years. This outcome is physically inconsistent, as it assumes the forest would be harvested in the first year for the purpose of giving credit but assumes harvesting would be spread out over 100 years for the purpose of reducing credits to account for leakage. As a result, most forest offset projects begin in greenhouse gas debt; project landowners generate offset credits that allow emitters in California to emit more than the state's emissions cap today, in exchange for promises that their lands will continue to increase their storage of carbon over 100 years.

Third, it is unclear whether the protocol requires forestland owners to increase carbon stocks to cover leakage for 25 years or for 100 years. The ambiguity relates to whether forestland owners are required to continue to maintain on-site growth to cover the impacts of leakage after the end of the project's 25-year crediting period. If forestland owners are only required to account for leakage for 25 years, participating projects could result in no net increase in carbon storage over 100 years compared to the baseline scenario.

The below table presents the actual emissions reductions achieved by projects under the protocol under different assumptions, reported as proportions of the credits already issued. For example, the cell on the upper left (100%) represents the assumptions underlying current policy. If these

assumptions are accurate, then 100% of the credits issued represent true emissions reductions. On the other hand, if these assumptions are inaccurate, the proportion of credits that represent actual emissions reductions can be much lower. The cell on the lower right (18%) shows that if the true leakage rate is 80% and ARB chose to only credit reductions already achieved, rather than reductions expected in the future, then the real reductions achieved to date by the project add up to only 18% of the credits issued.

This analysis was performed on all credits generated by 36 compliance forest offset projects through March 23, 2019. Collectively, these projects generated offset credits equal to 97 million tons of CO_2 reductions, which is 80% of the total credits that ARB has issued under its U.S. Forest protocol.

Actual emissions reductions by U.S. Forest offset projects as percent of credits issued to date

		Expected over 100 years (ARB's current approach)	Achieved to date (Recommended approach)
If the true leakage rate is:	20%	100%	65%
	40%	99%	49%
	60%	97%	33%
	80%	96%	18%

ARB can avoid the over-crediting discussed here with a few modifications to its protocol. ARB should (1) apply a leakage rate that is 80% or higher; and (2) determine the net benefits of reduced harvesting on an annual basis by accounting for both the increased carbon storage on site and the decreased carbon storage elsewhere due to leakage at the same time. This solution is reflected in the bottom right cell of the above table (18%).

These changes are needed for the protocol to be in accordance with current law and regulation. First, given the uncertainty in true leakage rates from reduced timber harvesting within the United States, using an 80% leakage rate or higher, as is supported by the academic literature, better fulfills the conservativeness principle laid out in ARB's cap-and-trade regulations.[1] Using low rates that are not reflected in published literature is unjustified and does not fulfill the conservativeness principle. Second, generating credits today for expected net reductions over many decades into the future runs contrary to the goals of California's Global Warming Solutions Act (AB32), the 2006 law authorizing California's cap-and-trade and offsets programs. This law states that for any trade in credits using a market-based compliance mechanism, the reductions credited should occur "over the same time period" and be "equivalent in amount to any direct emission reduction required" under California's climate change law.[2]

1 " 'Conservative' means, in the context of offsets, utilizing project baseline assumptions, emission factors, and methodologies that are more likely than not to understate net GHG reductions or GHG removal enhancements for an offset project to address uncertainties affecting the calculation or measurement of GHG reductions or GHG removal enhancements." California Code of Regulations, title 17, § 95802.

2 California Health & Safety Code § 38562(d)(3).

DETAILED DISCUSSION

How the U.S. Forest offset protocol works

The large majority of U.S. Forest offset projects credit forestland owners for holding more carbon on site per acre than they would have in the business-as-usual baseline scenario. Landowners must commit to maintaining those higher carbon levels for 100 years. Projects can be anywhere in the United States, and to date, approximately 20% of credits generated have been from projects in California, and 80% have been from projects elsewhere in the United States.

Most of these improved forest management projects define a business-as-usual baseline scenario that involves aggressive timber harvesting that brings on-site carbon storage close to the average per acre for forests in their region. The assumption is that these offset projects maintain higher on-site carbon stocks by reducing timber harvesting.

In the first year of an improved forest management offset project, the landowner earns offset credits for the amount of carbon on their land above the business-as-usual baseline scenario minus two factors. First, estimates of carbon released due to leakage are deducted. Second, not all loss of on-site carbon is released into the atmosphere. The protocol accounts for the portion of harvested timber that remains long-term in wood products like in houses and furniture and buried in landfills, which would be reduced if total timber harvesting is reduced by the project. Each subsequent year, the landowner is credited for any incremental increase in carbon sequestration on the participating lands as trees grow and sequester more carbon, minus the same two factors.

Leakage rate

ARB's U.S. Forest offset protocol uses a 20% leakage rate. A 20% leakage rate means that 20% of the reduction in timber harvesting caused an offset project is replaced by an increase in harvesting on other forestlands. The other 80% of the reduction is assumed not to be replaced and simply represents a decrease in timber use (i.e., fewer houses built, less paper produced, etc.)

Published literature suggests the leakage rate from reduced timber harvesting in the United States is at least 80%. Using a computable general equilibrium model, Gan & McCarl (2007) estimate that if timber production were reduced in the United States, 77% of that that timber harvesting would be displaced to other countries. Wear & Murray (2004) use econometric modeling to trace the effects of reductions in federal timber sales in the western United States in the late 1980s through the 1990s. They estimate that 84% of the reduced timber production was displaced to elsewhere within North America. Both articles underrepresent total leakage from conservation on U.S. forestlands. The former only estimates international leakage, ignoring leakage that might occur among forestland within the United States; the latter only estimates leakage in North America, ignoring leakage that could occur elsewhere. The existing academic literature on leakage rates from reduced forest harvesting does not support a 20% leakage rate. A conservative approach to addressing uncertainty in the true leakage rate would apply a leakage rate that is at least 80%.

The Climate Action Reserve, which developed the original U.S. Forest offset protocol on which ARB based its own protocol, revised its leakage rate from 20% to a sliding scale up to 80%, depending on the amount of timber harvesting performed by the offset project itself. Under this protocol, an 80% leakage rate is applied to offset projects that do not harvest at all.

The timing issue explained

As is typically done with offset projects, emissions reductions are estimated against a baseline scenario representing what would likely have happened without the offset program. Almost all ARB improved forest management offset projects define baseline scenarios that are well below their actual carbon stocks in their first year. On average across all projects analyzed, these baselines equal 70% of current carbon stocks. This means that in the first year of a project, the land owner is issued a quantity of credits equal to, on average, around 30% of the carbon stocks on their project lands, adjusted downward to account for leakage and any reduction in carbon held long-term in harvested wood products and landfills.

To create a baseline, the landowner models the carbon stocks and fluxes associated with a 100-year timber harvest scenario that reflects the harvesting expected to take place without the financial incentives from the offset program. The modeled scenario should be financially feasible and fulfill all legal and contractual obligations. In order for most projects to earn credits under the protocol, the calculated average carbon stocks in the baseline scenario over 100-years should be no less than that of the average forestlands for the project's region and forest type.

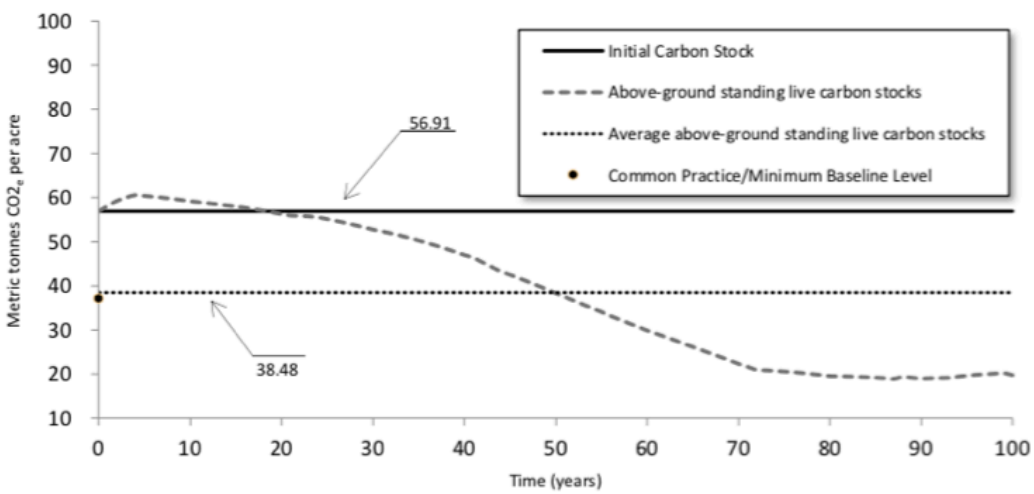
This modeled scenario is then abstracted into two key parameters used to calculate emissions reduced and credits generated by the project. Baseline on-site carbon storage and harvesting rates are assumed to equal the average values generated by the modeled scenario over 100 years. This simplified baseline is treated as equivalent, in terms of carbon accounting, to the range of financially feasible timber harvest scenarios that could have happened without the offset program. Flat average baseline values have the advantage of not requiring the landowner to calculate year-to-year increases in carbon storage against the harvest and growth cycles in one specific baseline management regime for each of 100 years. But this approach has one important disadvantage—flat average baseline values for carbon storage and harvest rates are internally contradictory and physically impossible.

The figure below presents an example of a modeled harvesting scenario used to define the baseline for one large offset project – ACR360, a half million acre project in southern Alaska. The curved dotted line is the modeled business-as-usual scenario for above-ground standing live carbon stocks. The straight dotted line is the baseline used to generate credits, which is the average above-ground standing live carbon stock in the 100-year modeled scenario. The solid line is the actual carbon storage on the project lands at the start of the project.

This simplified baseline scenario suggests that, if the project were not earning offset credits, its lands would be harvested to baseline levels in year 1 and maintained at those carbon stocking levels for 100 years. However, contradicting this assumption, the baseline also assumes that a constant quantity of timber is harvested each year over the project life, equal to the average rate over the 100-year modeled scenario. This second assumption is used to calculate leakage.

These two assumptions are contradictory because it is not possible for both carbon storage and harvesting to simultaneously remain at their respective average values over the project life. Carbon storage and harvesting rates are correlated with one another, and inextricably tied to the actual net growth rate of the project forest. If carbon storage is assumed to drop to the baseline in year 1, that would happen because of a large amount of timber harvesting. If the harvesting rate is assumed to be constant over 100 years, however, then the carbon storage on the land will also decrease slowly, rather than abruptly in year 1. By mixing these two assumptions into a physically impossible baseline scenario, the protocol maximizes credits generated without reflecting the actual rate at which emissions to the atmosphere are avoided. The protocol calculates gains in carbon against the baseline using the first assumption, and losses in carbon from leakage using the second assumption. As a result, credit generation is frontloaded, and landowners need to continue to increase net carbon storage for decades to make up for the leakage effects associated the reduced harvesting credited at the start of the projects.

Baseline carbon stocks for Finite Carbon – Ahtna Native Improved Forest Management offset project



From: ACR360 "Finite Carbon – Ahtna Native Alaskan IFM" Version 1.3, Attachments G and H: Baseline Carbon Stocks, Submittal Date: 1/19/2018

This over-crediting allows emitters in California to emit more than the state's emissions cap today in exchange for promises of forest carbon sequestration over 100 years to cover leakage from the start of the project. This is problematic for several reasons. First, emissions today are not equivalent to reductions decades from now given the urgency of climate change mitigation to avoid tipping points. California is designing its cap-and-trade and offset programs as models for other jurisdictions. If California exports a model that trades emissions today with reductions decades from now, California would promote a form of climate policy that fails to reduce emissions in these immediate critical years. Second, these promises can be difficult to keep since productivity slows in ageing forests (Gray et al 2016) and as forests respond to a warming climate. On project lands with less harvesting, fewer older trees will be replaced with younger trees, and the average tree age will increase over the 100 years of the project.

ACR360 generated close to 15 million offset credits in its first year, equal to more than 60% of the expected average annual effect of California's cap-and-trade program on emissions during 2021-2030.

The 25 year versus 100 year issue explained

If forestland owners are required to increase carbon to cover leakage for 100 years, then there would be no over-crediting over 100 years of the project. Over-crediting in the early years of the project would slowly be compensated as leakage is deducted each year for the project life.

However, it is unclear whether the protocol requires forestland owners to account for the emissions from leakage for 25 or for 100 years. The crediting period of a U.S. Forest offset project is 25 years. After the end of each 25-year crediting period, landowners can choose to renew their offset project for another 25 years but are not required to do so. For each year of a crediting period, landowners must report the net impact of the project on emissions taking into account any change in on-site carbon storage, and any releases due to leakage or reductions in carbon held long-term in harvested wood products and in landfills. If the net impact of the project in any year is negative, a *reversal* is understood to have occurred. The carbon reductions that were previously credited and later released must be replaced with additional procurement of allowance or offset credits.

How a reversal is defined after the last year of crediting is unclear in the protocol. Following the last year of crediting, forestland owners are required to maintain the credited on-site carbon storage for another 100 years. It is unclear if they are also required to ensure their forestland continues to grow to cover off-site releases due to leakage and due to reductions in carbon held long-term in harvested wood projects and landfills.

If forestland owners are only required to account for leakage for 25 years, crediting for reduced harvesting in the first year of the project will be awarded in full, while potentially, as low as only 1% of the leakage associated with that reduced harvest is deducted each year for only 25 years. It would be possible for participating projects to result in a net decrease in carbon storage over 100 years compared to the baseline.[3]

Methods

Landowners report how they calculate their requested credit issuance in Offset Project Data Reports (OPDRs) based on instructions laid out in the protocol. These reports are made public through the offset registries. We reproduce these calculations for all credits issued to 36 projects as of March 23, 2019. We use data provided by the landowner in their OPDRs and supplemental materials, and adjust the projects' assumptions for leakage and the timing of harvesting in the baseline to investigate the quantity of over-crediting.

Adjusted leakage rate

Using data reported in the OPDRs, we reproduce the calculations of leakage (also called *secondary effects*), carbon in harvested wood products and landfills (HWP&L), and total reductions achieved using leakage rates of 40%, 60%, and 80% instead of 20%.

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[3] Please see public comments submitted to ARB on May 10, 2018, *Comments on proposed cap-and-trade regulatory amendments*, for a more detailed discussion of this need to clarify and revise how the protocol defines a reversal after the last year of credit issuance, found at http://bhaya.berkeley.edu.

Adjusted timing of baseline harvesting
We recalculate the credits that would have been generated if the protocol's leakage calculations matched its assumption that timber is harvested in year 1 of the baseline scenario to bring carbon storage down to baseline levels, and continues to be harvested at smaller rates needed to maintain the baseline carbon storage level for one hundred years.

We do this in the following manner:

First, the baseline harvesting level prior to delivery to the mill (PDM) in the first year of the project is calculated as the difference between standing live carbon in the project compared to the baseline.

Second, we calculate the baseline carbon in trees harvested in years 2 to 100 so that the sum of the baseline PDM over 100 years is the same as the sum using ARB's current methods. We calculate the baseline PDM in years 2 through 100 (99 years) as:
$PDM_{\text{annual after year 1}} = (PDM_{\text{total}} – PDM_{\text{year 1}}) / 99$

Third, we recalculate the carbon in baseline HWP&L in a similar manner, by:
a) using the ratio of HWP&L to PDM in year 1 of the baseline in the OPDR to recalculate carbon in HWP&L in year 1 of the baseline for the revised PDM value;
b) calculating carbon in HWP&L in years 2 through 100 using the same process as for timber harvesting, so that the sum of carbon in HWP&L over 100 years of the baseline is the same in our estimates as it is in ARB's current estimates over the project life;

Fourth, we recalculate emissions reductions from the project using these revised leakage and carbon in HWP&L figures, and otherwise following the methods defined by the protocol.

When baseline or project PDM figures are missing from any of the OPDRs, we calculate the missing PDMs mathematically from other reported figures when possible, and apply the following assumptions when needed:

- The ratios of carbon in HWP&L to PDM remain the same across reporting periods.
- When the first reporting period does not equal exactly one year, the PDM in the first year is a prorated amount, reflecting what most projects with at least two reporting periods have done.
- The ratio of carbon in HWP&L to PDM is the same in both the baseline and project scenarios.

Other than the changes and assumptions described above, we repeat the methods used in the OPDRs to re-estimate emissions reduced and credits generated.

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